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Strategic Stability in Outer Space After Russia's Invasion of Ukraine

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Abstract

The space dimension is crucial in nuclear relations between the US and Russia. Space systems support vital functions like early warning, communication, reconnaissance, and targeting directly connected to strategic stability. However, shifting geopolitics and the disappearance of arms control agreements put the space dimension under strain. The Russian invasion of Ukraine showcases modern warfare's reliance on space assets. It also influences space dynamics and US-Russian relations. Although the current impact on strategic stability is limited, it is important to consider it. The most essential element of strategic stability in the space domain—the taboo against kinetic satellite attacks—endures, but there are reasons for concern. The broad use of civilian satellites for military purposes, Russia's evolving stance regarding targeting space objects, cyber-attacks against space infrastructure, the disappearance of provisions for non-interference with space assets, and sanctions affecting space industry—all of these in their separate ways could lead to crisis and undermine strategic stability. On top of this, the lack of dedicated channels for US-Russian dialogue on space security diminishes prospects for crisis prevention or mitigation.

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Cover image: "Falcon 9 rocket launches from Cape Canaveral Space Force Station, Fla.," Jan. 18, 2022, https://media.defense.gov/2022/Feb/03/2002932251/-1/-1/0/220131-F-KD758-192.JPG.

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Introduction

Outer space has always occupied an important place in thinking about nuclear weapons. Be it the development of nuclear forces, arms control efforts, or the concept of strategic stability, the space dimension has been impossible to ignore. Its importance is especially pronounced in the case of the world's two nuclear superpowers. Space systems are integral to nuclear and conventional capabilities in both the United States and Russia. They support critical functions such as communication, reconnaissance, intelligence gathering, and targeting. However, the renewed great power competition, the disappearance of arms control "guardrails," and the willingness of states to develop military capabilities across new domains put pressure on an already fragile status quo in outer space. Negative implications for strategic stability might follow.

A significant factor contributing to this trend is the Russian invasion of Ukraine. This conflict serves as a vivid example of modern warfare in which space assets have been heavily employed for military purposes and have been put in the crosshairs themselves as a result. And with relations between Moscow and Washington at their lowest level since the height of the Cold War, the nuclear factor has come to the forefront of bilateral relations once again.

The Russian invasion of Ukraine involves Moscow as a party to the conflict and Washington as head of a coalition providing support to Ukraine. Although the conflict is mostly confined to Ukrainian territory and is not being fought in space, its consequences extend to the space domain. The fallout of hostilities affects space-related developments and has broader implications for strategic stability. Although the changes to the status quo might seem relatively small at the moment, and we do not know how the situation will evolve in the future, it is important to put those new data points in the context of existing trends.

This paper describes the relations between strategic stability and outer space, examines the impact that the invasion of Ukraine has had on outer space and US-Russian strategic stability, and highlights the main trends in bilateral strategic stability.

Space and Strategic Stability

The 1990 Joint Statement on Future Negotiations on Nuclear and Space Arms and Further Enhancing Strategic Stability by the United States and the Soviet Union[1] described strategic stability as a state of affairs in which the risk of nuclear conflict is minimized because of a lack of incentive for any party to initiate a first nuclear strike. The statement indicated two factors supporting strategic stability: survivability of strategic nuclear forces and appropriate relationship between strategic offenses and defenses. Outer space is an important factor in all of the above.

Space-related activities and capabilities contribute to strategic stability in several ways:

- Space-based elements of early warning systems provide capabilities to promptly detect and track missile launches, including those of intercontinental ballistic missiles. These systems enable nations to have timely and accurate information about potential threats, reducing the possibility of a surprise attack and increasing the survivability of nuclear forces.
- Satellite systems play a critical role in ensuring secure and reliable communication between decision-makers and militaries. They support command and control functions and reduce the likelihood of communication breakdowns that could lead to inadvertent use of nuclear weapons or inability to use them.
- Intelligence, surveillance, and reconnaissance capabilities provided by satellites offer real-time and high-resolution data collection, which enhances transparency between nuclear-armed states, builds confidence, and reduces the potential for destabilizing actions.
- Deployment of interceptors in space has been considered one of the key elements of building a missile defense system capable of absorbing a nuclear strike from a peer competitor. The absence of such deployments maintained offense-defense in a manner that was broadly acceptable for both the United States and Russia.

At the same time, the dual-use nature of space technologies and the potential for space-based vulnerabilities, including the development of sophisticated anti-satellite (ASAT) weapons, introduced challenges to strategic stability. There are several scenarios of nuclear escalation involving space systems:

[1] *Soviet-United States Joint Statement on Future Negotiations on Nuclear and Space Arms and Further Enhancing Strategic Stability*, June 1, 1990, https://bush41library.tamu.edu/archives/public-papers/1938.

- Attacks on the space segment of nuclear command, control, and communication (NC3) or early warning systems.
- Development of a space-based missile defense system that could undermine the secure retaliatory capability.
- Deployment of land attack weapons in orbit that could target NC3 systems or nuclear weapons themselves.
- Space assets enabling escalation of conventional warfare to the nuclear level.
- Malfunctioning of the early warning and NC3 satellite systems, which could lead to misinterpretation of signals, resulting in unintended escalation.

Fortunately, none of these scenarios has materialized to date.

Reasons for the Status Quo

Although space-based systems have malfunctioned in the past, the other escalation scenarios involving outer space have not occurred, mainly because

> for the four-plus decades of the Cold War, nuclear weapons were the coin of the strategic realm. As both sides fielded space systems during this period, the safety of satellites was maintained by their close linkage to nuclear force structures....Decision-makers in Washington (and perhaps Moscow) presumed that an attack on space assets would prefigure a nuclear confrontation.[2]

Thus, not only were there no attacks against the satellites of the two nuclear superpowers, but in addition, no dedicated weapons systems were deployed in orbit around the Earth despite the permissibility of such a move (the 1967 Outer Space Treaty prohibits only the placement of weapons of mass destruction into orbit around the Earth[3]). Even specialized kinetic ASAT systems were eventually largely dropped by both the US and the Soviet Union after considering the idea from the 1960s to the 1980s.

For decades, outer space was shielded from weaponization and being turned into a battlefield by a combination of factors:

- Potential gains from deploying weapons in space and attacking space systems were limited, whereas the risks and losses were substantial.
- In the case of the United States and Russia, attack against certain space systems (mostly NC3) has been directly deterred by nuclear weapons. Other systems were protected from tampering by "noninterference with national technical means (NTMs)" clauses of the arms control treaties, starting with the SALT Interim Agreement of 1972.
- Finally, nuclear weapons served as a deterrent factor to a full-scale military confrontation between Moscow and Washington, which in turn limited the range of actions that the parties saw as possible or necessary, including actions in space.

[2] James P. Finch, "Bringing Space Crisis Stability Down to Earth," *Joint Force Quarterly* 76 (2015), https://ndupress.ndu.edu/JFQ/Joint-Force-Quarterly-76/Article/577582/bringing-space-crisis-stability-down-to-earth/.

[3] UNOOSA, *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, Jan. 27, 1967, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html.

According to the Basic Principles of State Policy of the Russian Federation on Nuclear Deterrence,[4] Moscow would consider nuclear use in case of "attack by adversary against critical governmental or military sites of the Russian Federation, disruption of which would undermine nuclear forces response actions." Early warning and communication satellites supporting nuclear forces definitely would be included in such critical infrastructure.

The US 2022 Nuclear Posture Review is much less specific, but it mentions that "nuclear weapons are required to deter not only nuclear attacks, but also a narrow range of other high consequence, strategic-level attacks."[5] The document leaves the definition of those attacks deliberately ambiguous but states elsewhere that the security environment poses a number of critical challenges for deterrence: "One challenge arises from advances in non-nuclear capabilities, including in the cyber, space, air, and undersea domains, that likely will create complex and unpredictable pathways for conflict escalation."[6]

It can be argued that over the last 75-plus years, a norm of no kinetic attacks against satellites and no deployment of weapons in space has been established.

As former head of Russian space agency "Roscosmos" Dmitry Rogozin said in 2021,

> It's crucial to understand that any hostile action against a space vehicle, especially if it belongs to a military constellation, can be a pretext for war. For this reason, many space vehicles are equipped with identification systems to precisely determine whether the damage inflicted on the craft resulted from a targeted human-made attack or from other causes, such as a meteoroid impact or internal malfunction. This tracking is essential because if the United States, Russia, or China suspects that their space vehicle has been attacked, it essentially amounts to an attack on the country itself.[7]

[4] Ministry of Foreign Affairs of the Russian Federation, *Basic Principles of State Policy of the Russian Federation on Nuclear Deterrenc*e, June 8, 2020, https://archive.mid.ru/en/web/guest/foreign_policy/international_safety/disarmament/-/asset_publisher/rp0fiUBmANaH/content/id/4152094.

[5] US Department of Defense, *2022 National Defense Strategy of the United States of America*, Oct. 27, 2022, https://www.defense.gov/National-Defense-Strategy/.

[6] US Department of Defense, *2022 National Defense Strategy of the United States of America*.

[7] Lidiya Misnik, "The War of the Future Will Begin in Space. A Major Interview with Dmitry Rogozin" ["Война будущего начнется в космосе". Большое интервью Дмитрия Рогозина], Gazeta.ru,, Aug. 29, 2021, https://www.gazeta.ru/politics/2021/08/29_a_13928414.shtml.

Space Assets: Setting the Stage

Although both Moscow and Washington have chosen not to target each other's space systems kinetically or maintain dedicated weapons in space, such actions could be taken, albeit at a considerable cost. The satellites are essentially "sitting ducks"—highly visible and moving on mostly predictable orbits. They are vulnerable targets that are nearly impossible to defend effectively.

Most commercial satellites are situated in low-Earth orbit (LEO) at an altitude between 300 and 2,000 kilometers, which is relatively close and cost-effective for deployment. Many military and dual-use satellites, including critical ones such as early warning and specific nuclear tracking satellites, are positioned in higher orbits, such as geostationary orbit (GEO), where they remain fixed over a specific point on Earth at about 35,786 kilometers, and highly elliptical orbit (HEO), where their altitude changes from 1,000 to more than 35,780 kilometers. For example, the Russian "Kupol" satellite constellation[8] serving as an early warning system for missile launches operates in HEO. The US Space-Based Infrared System constellation[9] is based in GEO, with some elements using HEO.

The US Global Positioning System (GPS) constellation—equipped with nuclear detonation detection sensors—is in medium-Earth orbit (MEO) at about 20,200 kilometers. The new generation of GLONASS satellites for the Russian GPS, which appears to also be equipped with a nuclear detection sensor payload,[10] is also deployed in MEO.[11] The now-decommissioned US Space Tracking and Surveillance System aimed at tracking missile launches was placed in LEO at about 1,350 kilometers. The US Proliferated Warfighter Space Architecture—a satellite constellation under development tasked with detecting and tracking missiles in flight—is using LEO of about 1,000 kilometers.

One way to threaten those satellites would be targeting them with ground-launched missiles. Four countries have conducted destructive direct-ascent tests of ASAT weapons: the United

[8] Anatoly Zak, "Kupol (EKS/Tundra) Satellite," Russian Space Web, Nov. 3, 2022, https://www.russianspaceweb.com/eks-tundra.html.

[9] "Space Based-Infrared System (SBIRS)," Lockheed Martin, https://www.lockheedmartin.com/en-us/products/sbirs.html.

[10] Bart Hendrickx, "The Secret Payloads of Russia's Glonass Navigation Satellites," The Space Review, Dec. 19, 2022, https://www.thespacereview.com/article/4502/1.

[11] Maddie Saines, "Russia Launches Glonass-K2 No.13," GPS World, Aug. 25, 2023, https://www.gpsworld.com/russia-launches-glonass-k2-no-13/.

States, China, India, and Russia. These tests involved launching missiles to destroy their own decommissioned satellites.

The US first destroyed its own satellite with an air-launched ASAT missile on September 13, 1985, at an altitude of 555 kilometers. On February 21, 2008, the US destroyed its own malfunctioning satellite using a ship-fired RIM-161 Standard Missile 3 at an altitude of about 247 kilometers. In late 2021, Russia showcased its direct-ascent ability to eliminate targets in LEO through a live-fire, hit-to-kill demonstration. During this event, a Russian missile successfully struck the old Soviet military intelligence satellite Kosmos-1408, which was positioned at an altitude of 465 to 490 kilometers.[12] Both countries have other exoatmospheric missile defense systems, which should by definition be capable of targeting satellites in LEO.

Because of the complexity of reaching satellites in higher orbits, those satellites are better protected. Although low-Earth satellites can be relatively easily intercepted with anti-ballistic missile systems, the same is not true for satellites in higher orbits. Intercepting HEO and GEO satellites would require deploying other satellites in space. These "satellite-killer" assets could approach and neutralize or disable their targets. According to the Secure World Foundation's Global Counterspace Capabilities 2023 report, both Russia and the United States have conducted multiple tests of technologies for rendezvous and proximity operations in GEO, along with tracking, targeting, and intercept technologies that could lead to a co-orbital ASAT capability. However, none of these tests and demonstrations in GEO were conducted for offensive missions.[13]

Both the US and Russia previously ran specific ASAT programs and conducted several tests on such missions. Both countries deploy so-called inspector satellites capable of maneuvering in space to approach other space objects and examine them. There has even been a recent allegation of an inspector satellite firing a projectile.[14] At the same time, such satellites require significant amounts of fuel to change their orbits to pursue adversary satellites, which limits their capabilities. Their numbers also remain in the single digits. Beginning in the 1960s, the Soviet Union ran a program of co-orbital interceptors (including destructive testing), but it closed in the 1980s.

[12] "The Russian Military Has Confirmed That They Shot Down a Soviet Satellite During Tests" ["Военные РФ подтвердили, что сбили советский спутник в ходе испытаний"], Interfax, Nov. 16, 2021, https://www.interfax.ru/russia/803293.

[13] Brian Weeden and Victoria Samson, eds., *Global Counterspace Capabilities: An Open Source Assessment*, 2023, Secure World Foundation, https://swfound.org/counterspace.

[14] In 2020, the US alleged that Russian satellite Cosmos 2543 fired a projectile into outer space. See W. J. Hennigan, "America Really Does Have a Space Force. We Went Inside to See What It Does," *Time*, July 23, 2020, https://time.com/5869987/spaceforce/.

Both countries have been working on non-kinetic weapons that could be used to target satellites. According to Russian officials, Moscow has deployed and is mass-producing the "Peresvet" mobile laser system. In 2022, Russian Deputy Prime Minister Yuri Borisov announced that Peresvet is capable of dazzling and disabling satellites at altitudes up to 1,500 kilometers.[15] No information is publicly available about the live testing of the system.

[15] "Borisov: The Laser System Peresvet Allows Blinding Satellites at Altitudes of up to 1,500 Kilometers" ["Борисов: лазерный комплекс "Пересвет" позволяет ослеплять спутники на высоте до 1 500 км"], TASS, May 18, 2022, https://tass.ru/armiya-i-opk/14655039.

What's New?

Since the start of the Russian invasion of Ukraine in February 2022, several developments have occurred with direct implications for the role of outer space in the strategic stability paradigm.

It is important to begin with the rapid deterioration of bilateral relations between Russia and the United States following the invasion of Ukraine. To a certain extent, the situation is unprecedented. Washington has imposed on Moscow the broadest sanction regime in history. It has been providing Kyiv with advanced weapons systems, including missile defenses, high-precision missiles, tanks, and fighter aircraft. US officials have said that they want Russia to be "weakened"[16] and to see Russia's "strategic defeat."[17]

At the same time, Moscow has shown willingness to go to great lengths to achieve its goals. Russian President Vladimir Putin has repeatedly issued threats of "ominous" and "lightning-fast" consequences to those interfering with Russia's invasion.[18] These statements were broadly perceived in the West as euphemisms for nuclear use and set off a series of public reactions in the subsequent weeks and months, with a number of counterthreats made.[19] Russia announced large-scale military mobilization for the first time since World War II, suspended arms control agreements with the US, and increased pressure on the US military. In March 2023, a Russian fighter jet damaged an American MQ-9 Reaper drone, causing it to crash into the Black Sea.

[16] Missy Ryan and Annabelle Timsit, "US Wants Russian Military 'Weakened' from Ukraine Invasion, Austin Says," *Washington Post*, Apr. 25, 2022, https://www.washingtonpost.com/world/2022/04/25/russia-weakened-lloyd-austin-ukraine-visit/.

[17] Camille Gijs and Hannah Roberts, "Western Allies Ramp Up Rhetoric Against Russia, Want 'Defeat' of Moscow," Politico, May 20, 2022, https://www.politico.eu/article/western-allies-nato-us-uk-eu-against-russia-want-to-see-defeat-moscow/.

[18] See "Address by the President of the Russian Federation," Feb. 24, 2022, http://en.kremlin.ru/events/president/news/67843; "Meeting with Female Aircrew Members of Russian Airlines," Mar. 5, 2022, http://en.kremlin.ru/events/president/news/67913; and "Address by the President of the Russian Federation," Sept. 21, 2022, http://en.kremlin.ru/events/president/news/69390.

[19] See Steve Holland, "US Making Plans in Case Russia Uses Chemical, Nuclear Weapons," Reuters, Mar. 24, 2022, https://www.reuters.com/world/us/us-making-plans-case-russia-uses-chemical-nuclear-weapons-2022-03-24/ and "Poutine Must Understand That NATO Is a Nuclear Alliance, Says Le Drian" [«Poutine doit comprendre» que l'OTAN «est une alliance nucléaire», lance Le Drian], Le Figaro TV, Feb. 24, 2022, https://video.lefigaro.fr/figaro/video/poutine-doit-comprendre-que-lotan-est-une-alliance-nucleaire-lance-le-drian/.

The status quo in outer space, based on cost-benefit calculations, mutual restraint, and certain unwritten rules of the road, has been put under pressure after all of those principles came into question.

Cyberattacks on satellite networks

On February 24, 2022, one hour before the start of the Russian invasion, a cyberattack disrupted broadband satellite internet access in parts of Europe, including Ukraine.[20] The attack resulted in a partial interruption of broadband service from the KA-SAT satellite, owned by the US company Viasat, Inc. The attack, caused by a new strain of wiper malware called "Acid Rain," was designed to remotely erase vulnerable modems and routers.[21] Because the Ukrainian armed forces depended on Viasat's services for command and control, the cyberattack led to a significant loss of communication in the earliest days of the war, hampering the forces' operational effectiveness, as confirmed later by Ukrainian officials.[22] Although the attack primarily focused on targeting Viasat's ground terminals, part of which served military infrastructure, it also resulted in collateral damage to civilian objects across Europe, such as the outage experienced by 5,800 Enercon wind turbines (about one-fifth) in Germany.[23]

On May 10, 2022, United Kingdom, European Union, and US authorities formally accused Russia of the Viasat satellite hack and condemned its actions.[24] The official statement from the United States also emphasized that "Russian military cyber operators have deployed multiple

[20] "KA-SAT Network Cyber Attack Overview," Viasat Corporate News, Mar. 30, 2022, https://news.viasat.com/blog/corporate/ka-sat-network-cyber-attack-overview.

[21] Juan Andres Guerrero-Saade and Max van Amerongen, "AcidRain: A Modem Wiper Rains Down on Europe," Sentinel Labs, Mar. 31, 2022, https://www.sentinelone.com/labs/acidrain-a-modem-wiper-rains-down-on-europe/.

[22] Patrick Howell O'Neill, "Russia Hacked an American Satellite Company One Hour Before the Ukraine Invasion," MIT Technology Review, May 10, 2022, https://www.technologyreview.com/2022/05/10/1051973/russia-hack-viasat-satellite-ukraine-invasion/.

[23] "Satellite Outage Knocks Out Thousands of Enercon's Wind Turbines," Reuters, Feb. 28, 2022, https://www.reuters.com/business/energy/satellite-outage-knocks-out-control-enercon-wind-turbines-2022-02-28/.

[24] See UK Government, "Russia Behind Cyber-Attack with Europe-Wide Impact an Hour Before Ukraine Invasion," May 10, 2022, https://www.gov.uk/government/news/russia-behind-cyber-attack-with-europe-wide-impact-an-hour-before-ukraine-invasion; Council of the EU, "Russian Cyber Operations Against Ukraine: Declaration by the High Representative on Behalf of the European Union," May 10, 2022, https://www.consilium.europa.eu/en/press/press-releases/2022/05/10/russian-cyber-operations-against-ukraine-declaration-by-the-high-representative-on-behalf-of-the-european-union/; and Antony J. Blinken, "Attribution of Russia's Malicious Cyber Activity Against Ukraine," May 10, 2022, US Department of State, https://www.state.gov/attribution-of-russias-malicious-cyber-activity-against-ukraine/.

families of destructive wiper malware, including WhisperGate, on Ukrainian Government and private sector networks."[25]

After the attack on Viasat, the Ukrainian government reached out to SpaceX and its chief executive officer Elon Musk for assistance in restoring internet connectivity. In response to Ukraine's request, SpaceX quickly transported thousands of Starlink terminals to the country, enabling the establishment of an independent infrastructure. However, the attacks against Ukrainian communication networks persisted. At the beginning of March 2022, Musk wrote via Twitter, "Some Starlink terminals near conflict areas were being jammed for several hours at a time."[26] Because of a subsequent software update, the infrastructure was able to adapt to challenges and counter the attacks. The conflict has also seen multiple instances of signal jamming coming from the GPS satellites.[27]

The abovementioned examples deal with cyberattacks, which are most of the time reversible and harder to attribute to a specific country than conventional strikes. They were also attacks against civilian infrastructure, not military infrastructure. Nevertheless, attacks of any kind against satellites could mean that a new page has been turned in modern warfare.

Both the US and Russian militaries depend on satellite systems for everything from communication to data gathering and targeting. The examples in question show that there is clear rationale and precedent for attacking them in times of hostilities. If US satellites have been targeted in a conflict in which Washington is not participating in the fighting, it is safe to assume that a direct confrontation would lead to even broader engagement of space systems.

In terms of strategic stability, attacking space systems is not off the table in potential future conflicts, opening the possibility for still further escalation.

Satellites as legitimate targets for attack

Another noteworthy development was Russia's readiness to consider satellites supporting the opposing side as legitimate targets for attack, regardless of their country of origin.

The Ukrainian military has been actively using commercial satellites (from Starlink, Iridium, Maxar, Planet Labs, and BlackSky—all US companies) to provide battlefield communication, surveillance, and drone operation, among other things. To make things even more complicated,

[25] Blinken, "Attribution of Russia's Malicious Cyber Activity Against Ukraine."

[26] Elon Musk (@elonmusk), "Some Starlink terminals near conflict areas were being jammed for several hours at a time. Our latest software update bypasses the jamming," Tweet, Twitter, Mar. 5, 2022, https://twitter.com/elonmusk/status/1500026380704178178.

[27] Elisabeth Howell, "Russia Is Jamming GPS Satellite Signals in Ukraine, US Space Force Says," Space.com, Apr. 13, 2022, https://www.space.com/russia-jamming-gps-signals-ukraine.

some of those space systems have been tasked or even directly controlled (in the case of Starlink[28]) by the US government. Russia has repeatedly asserted that these satellites are legitimate targets for destruction.

On September 12, 2022, at the second session of the Open-Ended Working Group on Reducing Space Threats Through Norms, Rules and Principles of Responsible Behaviors, Deputy Director of the Russian Foreign Ministry's Department of Nonproliferation and Arms Control Konstantin Vorontsov stated:

> We would like to underline an extremely dangerous trend that goes beyond the harmless use of outer space technologies and has become apparent during the events in Ukraine. Namely, the use by the United States and its allies of the elements of civilian (including commercial) infrastructure in outer space for military purposes. It seems like our colleagues do not realize that such actions in fact constitute indirect involvement in military conflicts. Quasi-civilian infrastructure may become a legitimate target for retaliation.[29]

On October 26, 2022, Mr. Vorontsov repeated the same statement at the Thematic Discussion on Outer Space (Disarmament Aspects) in the First Committee of the 77th Session of the United Nations General Assembly.[30]

In response, White House Press Secretary Karine Jean-Pierre stated that "any attack on US infrastructure will be met with a response…in a time and manner of our choosing….We will pursue all means to explore, detect and hold Russia accountable for any such attacks."[31]

What exactly Russian officials meant by "retaliation" is unclear—kinetic destruction of satellites would obviously be very different from cyberattacks or jamming of signals. Officials

[28] "Elon Musk Was Right to Cede Starlink Access to Pentagon, Says Biographer," The New Voice of Ukraine, Sept. 13, 2023, https://english.nv.ua/nation/elon-musk-was-right-to-cede-starlink-access-to-pentagon-says-biographer-50353363.html.

[29] The Ministry of Foreign Affairs of the Russian Federation, "Speech of the Head of the Russian Federation Delegation K.V. Vorontsov at the Second Session of the Open-Ended Working Group Established by UN General Assembly Resolution 76/231" [Выступление главы делегации Российской Федерации К.В.Воронцова на второй сессии Рабочей группы открытого состава, учрежденной резолюцией ГА ООН 76/231], Sept. 12, 2022, https://www.mid.ru/ru/foreign_policy/news/1829796/; an unofficial English translation of the same statement by UNODA can be found at https://documents.unoda.org/wp-content/uploads/2022/09/Unofficial-translation-in-English.pdf.

[30] Permanent Mission of the Russian Federation to the United Nations, "Statement by Deputy Head of the Russian Delegation Mr. Konstantin Vorontsov at the Thematic Discussion on Outer Space (Disarmament Aspects) in the First Committee of the 77th Session of the UNGA," Oct. 26, 2022, https://russiaun.ru/en/news/261022_v.

[31] The White House, "Press Gaggle by Press Secretary Karine Jean-Pierre En Route Syracuse, NY," Oct. 27, 2022, https://www.whitehouse.gov/briefing-room/press-briefings/2022/10/27/press-gaggle-by-press-secretary-karine-jean-pierre-en-route-syracuse-ny/.

have also been talking about civilian satellites being used for military purposes, not US military satellites.

The statements by representatives of the Russian Ministry of Foreign Affairs also appear to contradict other official Russian positions. For example, a document presented to the same Open-Ended Working Group a year later in 2023 stated that "the Russian Federation proceeds from the inadmissibility of conflicts in outer space in principle as bearing a serious existential threat to all humankind." [32] The Draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects proposed by Russia and China in 2014 would commit the parties to "not resort to the threat or use of force against outer space objects of States Parties."[33]

Regardless, the statement has now become a part of Moscow's talking points. For the first time, Russian and US officials started speaking about satellites as legitimate targets in military conflict, bringing this possibility closer to reality. In addition to creating debris, an attack against any satellite would break the norm and open the door to other attacks. It would most likely also trigger retaliation, which could also occur in outer space.

Suspension of the New START

The New START treaty[34] served as a vital framework for controlling the nuclear arsenals of Russia and the United States. In addition, it included a commitment not to interfere with each other's NTMs of verification (including satellites). This provision played a crucial role in fostering trust and confidence, enabling both nations to monitor and verify compliance by using technical assets.

The New START treaty was only the last in a series of agreements that included the "non-interference" provision. The provision first appeared in the 1972 Interim Agreement on Certain Measures with Respect to the Limitation of Strategic Offensive Arms more than 50

[32] "On Counterproductive Nature of Consideration of the Applicability of International Humanitarian Law to Outer Space Activities" (advanced unedited version), Russian Federation's working paper published at UNODA, Jan. 30, 2023, https://docs-library.unoda.org/Open-Ended_Working_Group_on_Reducing_Space_Threats_-_(2022)/IHL_Unofficial_translation_итог-1.pdf.

[33] Ministry of Foreign Affairs of the People's Republic of China, *Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects*, June 16, 2014, https://www.fmprc.gov.cn/mfa_eng/wjb_663304/zzjg_663340/jks_665232/kjfywj_665252/201406/t20140616_599726.html.

[34] US Department of State, *Treaty Between the United States of America and The Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms*, Apr. 8, 2010, https://2009-2017.state.gov/documents/organization/140035.pdf.

years ago.[35] The exact details of the provision were never openly defined, but non-interference was distinct from "deliberate concealment measures which impede verification by national technical means"[36] and probably meant prohibition of any engagement with the satellites that could impede their use for verification purposes. Because neither the US nor the Soviet Union/Russia fully disclosed the missions of their satellites, the provision had to cover a broad range of space systems.

Because of the significant deterioration in relations between Russia and the US after the invasion of Ukraine, Moscow suspended its participation in the New START treaty in February 2023.[37] Commenting on the fate of the treaty, Russian presidential spokesperson Dmitry Peskov accused Washington of undermining "the legal basis in the field of arms control and security" and creating extremely hostile conditions. He specifically highlighted the role of space in this process: "We see how the entire NATO [North Atlantic Treaty Organization] intelligence infrastructure—including reconnaissance aircraft and satellite constellations—works 24/7 in the interests of the Ukrainian regime."[38]

Russia did not withdraw from New START completely. Moscow emphasized that it is willing to voluntarily uphold the treaty's provisions regarding nuclear weapons limits. However, with the treaty no longer in force, the non-interference provision has disappeared, potentially opening avenues for tampering with or disrupting each other's satellite systems. The parties were also left free to conceal their strategic assets.

If Russia and the US begin to aggressively conceal their strategic delivery systems from overhead satellites, such actions will add to already-increased non-transparency. Lack of transparency will lead to fear of violation of New START limits, which could push the countries to increase their nuclear arsenals, with negative consequences for strategic stability. Absence of legal limitations on interference with satellites will make them an easier target for militaries, especially in combination with all of the other factors mentioned previously.

The 50-year norm of non-interference with NTMs has been a legally binding obligation continuously since 1988 (Intermediate-Range Nuclear Forces treaty). It meant that Russian

[35] US Department of State, *Interim Agreement Between the United States of America and the Union of Soviet Socialist Republics on Certain Measures with Respect to the Limitation of Strategic Offensive Arms*, May 26, 1972, https://2009-2017.state.gov/t/isn/4795.htm.

[36] US Department of State, *Interim Agreement,* Article V.3.

[37] The Ministry of Foreign Affairs of the Russian Federation, "Foreign Ministry Statement in Connection with the Russian Federation Suspending the Treaty on Measures for the Further Reduction and Limitation of Strategic Offensive Arms (New START)," Feb. 21, 2023, https://mid.ru/en/foreign_policy/news/1855184/.

[38] "Peskov Believes That the Entire NATO Military Infrastructure and Satellites Are Operating Against Russia" ["Песков считает, что вся военная инфраструктура и спутники НАТО работают против России"], TASS, Feb. 1, 2023, https://tass.ru/politika/16935519.

and US militaries followed a certain set of agreed rules. It also meant that—at least on the surface—the military planning of the two countries had to incorporate those provisions.

There have already been signs that the Russian military is considering ways to protect its strategic forces from satellite observation. The previously mentioned Peresvet laser system has been co-deployed with the strategic road-mobile missile forces, and Russian officials have stated that it can disable observation satellites. Suspension of the New START treaty will only accelerate this trend.

Finally, the suspension of the New START treaty closed one of the last avenues for US-Russian engagement on strategic stability that included the space angle. Although the Bilateral Consultative Commission was a technical body mostly dealing with the implementation of the New START treaty, it was an important and regular forum for bilateral interactions. A broad, comprehensive US-Russian dialogue on strategic stability was reestablished by the Biden Administration in 2021 before being suspended by the US following the Russian invasion of Ukraine in 2022.

Space systems as enablers of conventional capabilities

Space systems were also involved in a series of key nuclear-related events in the current conflict. On December 5, 2022, a Ukrainian drone attacked Engels Air Base, situated about 600 kilometers east of the Ukrainian border and host to Tu-160 and Tu-95 long-range strategic bombers. Since the start of the war, it was one of two bases used to deploy bombers conducting missile strikes on Ukraine.[39] There were reports of damage to two Tu-95 bombers. On the same day, another explosion took place at the Dyagilevo military air base near Ryazan, which also hosted strategic bombers. On December 26, 2022, Ukraine attacked Engels Air Base again, killing three Russian servicemembers.[40]

Attacks continued in August 2023, when two more Russian strategic aviation air bases were targeted by drone strikes. These strikes occurred at the Soltsy Air Base, located more than 360 miles north of the Ukraine border, and the Shaikovka Air Base, situated about 200 miles from Ukraine. As reported, the attack on Shaikovka resulted in the destruction of at least one Russian

[39] Pavel Polityuk and Sergiy Chalyi, "Ukraine Appears to Expose Russian Air Defence Gaps with Long-Range Strikes," Reuters, Dec. 6, 2022, https://www.reuters.com/world/europe/ukraine-warns-emergency-blackouts-after-more-missile-hits-2022-12-05/.

[40] Pjotr Sauer, "Three Russian Servicemen Dead After Ukrainian Drone Attack, Moscow Says," *The Guardian*, Dec. 26, 2022, https://www.theguardian.com/world/2022/dec/26/three-russian-servicemen-die-after-ukrainian-drone-attack-moscow-says.

Tu-22 M3 bomber; Ukrainian sources indicated that the attacks led to the destruction of two Russian bombers and inflicted damage on two other aircraft. The Russian Defense Ministry acknowledged damage to one aircraft in the Soltsy strike.[41] Although the Tu-22 M3 is not counted as a strategic bomber under the New START definitions, its range and weapons make it a de facto strategic asset.

A few days after the first strike, Konstantin Gavrilov, head of the Russian delegation at the Vienna Negotiations on Military Security and Arms Control, stated that the strikes on the Russian strategic airfields Dyagilevo and Engels posed significant risks. He also noted that the drones used in the attack had been modernized with the help of a US company and had the capability of being guided using US GPS.[42] Earlier, Russian state media reported that US commercial satellites had taken images of Engels Air Base before the drone attack, hinting at help with targeting.[43]

Moscow later justified the continued suspension of inspections under the New START treaty and subsequent suspension of the treaty altogether by claiming that the US had attempted to "probe" the security of Russian strategic facilities declared under the treaty by assisting Kyiv in conducting armed attacks against them.[44]

The attacks potentially have broad implications for strategic stability. Both the Tu-95 and the Tu-22 M3 remain key elements of the air leg of Russia's nuclear triad. The incidents represented the first military assaults on strategic nuclear bases in history.

Russian nuclear deterrence doctrine—the Basic Principles of State Policy of the Russian Federation on Nuclear Deterrence—clearly states that "attack by adversary against critical governmental or military sites of the Russian Federation, disruption of which would undermine nuclear forces response actions" would be a condition for Moscow to consider

[41] Graeme Baker, "Ukrainian Drone Destroys Russian Supersonic Bomber," BBC, Aug. 22, 2023, https://www.bbc.com/news/world-europe-66573842.

[42] The Ministry of Foreign Affairs of the Russian Federation, "The Speech of the Head of the Russian Federation Delegation K.Y. Gavrilov on the Negotiations in Vienna on Matters of Military Security and Arms Control, at the 1030th Plenary Meeting of the OSCE Forum on Security Cooperation" [Выступление руководителя Делегации Российской Федерации на переговорах в Вене по вопросам военной безопасности и контроля над вооружениями К.Ю.Гаврилова на 1030-м пленарном заседании Форума ОБСЕ по сотрудничеству в области безопасности], Dec. 7, 2022, https://www.mid.ru/ru/foreign_policy/news/1842528/.

[43] "American Satellites Were Capturing Images of an Airfield in Engels Prior to the Ukrainian Armed Forces' Strike" ["Американские спутники снимали аэродром в Энгельсе перед ударом ВСУ"], RIA Novosti, Dec. 5, 2022, https://ria.ru/20221205/engels-1836516596.html.

[44] Gabrielle Tétrault-Farber, "Russia Says It Suspended Nuclear Pact Because US Was Using It to Help Ukraine," Reuters, Mar. 2, 2023, https://www.reuters.com/world/russia-says-it-suspended-nuclear-pact-because-us-was-using-it-help-ukraine-2023-03-02/.

nuclear use.[45] But in this instance, Russian officials have not even brought up this possibility. The nuclear issue has not been raised. Moscow retaliated with conventional strikes against targets in Ukraine.

Attack against a nuclear-armed state's dual-capable systems has long been one of the more worrisome scenarios of nuclear escalation because of the unpredictability of perceptions and subsequent decisions. The Russian air base attacks showed that countries can, under certain circumstances, distinguish the scope of and reasons behind the attacks (whether the bombers were targeted as conventional or nuclear platforms, etc.) and act accordingly.

Whether a similar attack from a nuclear weapons state would have led to a different response is an open question. But alleged or real use of US space assets for targeting and navigation of the drones did not seem to change the calculus.

In the short term in the US-Russian context, the attacks led to a certain weakening of Russian strategic aviation and movement of strategic bombers to fewer air bases, making them more vulnerable to a hypothetical first strike. Ukraine's successful targeting of strategic bombers also exposed the bombers' vulnerability to conventional attacks supported by space capabilities.

Effect of sanctions on Russia's space capabilities

Finally, the Russian invasion of Ukraine might have affected US-Russian strategic stability in a rather unexpected way, through a reduction in Moscow's space capabilities.

The US and its allies imposed extensive economic sanctions, targeting Russia's financial institutions, industries, and officials. The Russian space and technology sectors were particularly affected, with a specific focus on commercial technologies and exports. These latest sanctions built upon the already-existing sanctions regime dating back to 2014. For example, several Russian space enterprises, including Samara Space Rocket Center "Progress" and "Central Research Institute of Machine Building'' (TsNIImash), were added to the US sanction lists long before 2022. Notably, even key figures such as Dmitri Rogozin, former deputy prime minister and head of Roscosmos state corporation, have been subject to individual sanctions.

One significant consequence of the sanctions has been the restriction of Russia's access to commercial markets in North America and Europe. The sanctions have limited Russia's

[45] Ministry of Foreign Affairs of the Russian Federation, *Basic Principles of State Policy*.

opportunities for collaboration and partnerships. Efforts to mitigate these challenges by collaborating with other countries, such as China, have had mixed results.

Restrictions on the import of critical components, including advanced microelectronics, have already resulted in delays and disruptions in the supply chain. For instance, Russia's early warning satellite program, known as the Kupol constellation (or EKS system), is facing delays because of production problems and sanctions. The initial goal was to deploy 10 "Tundra" early warning satellites, as well as several geostationary satellites, by 2020[46] to support the replacement of the Soviet-era "Oko" and "Oko-1" systems. However, the full deployment of the satellite constellation has been delayed twice, with only 6 of 10 planned satellites in orbit as of 2023. Experts suggest that given the sanctions regime, the completion of the constellation will not happen before 2026.[47]

The biggest challenge for Kupol could be obtaining microelectronics, a critical element for satellite production. Some sources indicate that Russia heavily relies[48] on foreign components for its space technologies (e.g., radiation-hardened chips used in satellites[49]), and the frequent changes in suppliers have caused delays because each new component requires testing and evaluation to ensure that it meets the necessary characteristics. Another problem affecting the program's effectiveness is tied to the launch vehicle for planned geostationary satellites, the "Angara-A5" rocket. Frequent production disruptions have resulted in legal disputes between the Russian Defense Ministry and Khrunichev Center, the manufacturer of these rockets.[50]

Russian Defense Minister Sergei Shoigu called the current number of deployed Tundra satellites sufficient for "continuous monitoring of missile-threat regions in the Northern

[46] "The Russian Aerospace Forces Are Set to Receive Over 900 New Aircraft and Helicopters by 2020" ["ВКС России получат до 2020 года более 900 новых самолетов и вертолетов"], TASS, Dec. 20, 2016, https://tass.ru/armiya-i-opk/3889513.

[47] Maxim Starchak, "Sanctions Further Delay Russian Missile Early Warning Program in Space," Defense News, Mar. 12, 2023, https://www.defensenews.com/space/2023/03/12/sanctions-further-delay-russian-missile-early-warning-program-in-space/.

[48] Aime Williams, Eleanor Olcott, and Kathrin Hille, "Chip Sanctions Aim for Russia's Military and Its Tech Industry Hopes," *Financial Times*, Feb. 27, 2022, https://www.ft.com/content/1d0e97dd-b7e3-416c-98a0-a823838fbc96.

[49] David T. Burbach, "Early Lessons from the Russia-Ukraine War as a Space Conflict," Atlantic Council, Aug. 30, 2022, https://www.atlanticcouncil.org/content-series/airpower-after-ukraine/early-lessons-from-the-russia-ukraine-war-as-a-space-conflict/.

[50] "The Court Has Ordered the Khrunichev Center to Pay 32 Million Rubles as a Result of the Ministry of Defense's Lawsuit" ["Суд взыскал с Центра Хруничева 32 миллиона рублей по иску Минобороны"], RIA Novosti, May 16, 2023, https://ria.ru/20230516/minoborony-1872151474.html.

Hemisphere."[51] However, even some Russian military experts argue that a comprehensive space system should cover not only the territory of the United States but also the areas where American ballistic missile–carrying submarines patrol. An incomplete system consisting of only 6 satellites instead of the planned 10 might underperform.[52]

Although sanctions have presented some challenges and affected the military space production and task schedules, their effect for now has not been critical or significantly disruptive. Russia has a long history of coping with economic difficulties, and the defense sector is prepared to face negative scenarios to a certain extent. Russia's space budget, including military expenses, has remained relatively stable in 2022 and 2023.[53] Nonetheless, a deficit of critical components might lead to further delays and gradual aging and deterioration of space systems.

The consequences of such deterioration for strategic stability would be manifold. On one hand, Russia might feel vulnerable, prompting the Kremlin to intensify the development of its nuclear forces and even change its force posture.[54] On the other hand, Russia's inability to update and enhance its space-based NC3 systems could lead to reconnaissance errors, misinterpretation of incoming signals, and disruptions in the chain of command. All these factors could contribute to nuclear escalation and would increase the risks of inadvertent use.

It is worth noting that in the past, the quality of other nuclear superpowers' early warning systems was deemed important enough that it led to the creation of the Russian-American Observation Satellites program, sponsored by the Pentagon, in 1992. Its aim was to foster cooperation between former Cold War adversaries by focusing on enhancing space-based early warning capabilities, specifically improving the detection of dim targets and reducing false alarms. Although the program was ultimately canceled by Washington in 2004, it had significant achievements, including successful preliminary design reviews of both American and Russian segments.

[51] "Shoigu Announced the Launch of the Sixth Kupol Spacecraft" ["Шойгу заявил о запуске шестого космического аппарата 'Купол'"], RIA Novosti, Dec. 21, 2022, https://ria.ru/20221221/kupol-1840279493.html.

[52] "Russia Has Disclosed Its Inability to Monitor US Nuclear Launches" ["В России рассказали о неспособности следить за ядерными пусками США"], Lenta.ru, June 5, 2020, https://lenta.ru/news/2020/06/05/tundra/.

[53] Pavel Luzin, "Russian Space Spending for 2023," *Eurasia Daily Monitor* 20, no. 25, Feb. 10, 2023, https://jamestown.org/program/russian-space-spending-for-2023/.

[54] Michael Kofman et al., *Assessing Russian State Capacity to Develop and Deploy Advanced Military Technology*, CNAS, Oct. 2022, https://s3.us-east-1.amazonaws.com/files.cnas.org/documents/CNAS-Report-RussianTechnology-Oct22-TSP.pdf.

Things to Watch

This paper described a few trends that the Russian invasion of Ukraine brought to the outer space domain that could undermine strategic stability. But it is important to keep in mind that these trends are unfolding against the backdrop of other processes, some of which could have a significant impact and must be closely followed.

First, to achieve a reliable capability to target an adversary's satellites (whether commercial or military), as opposed to a one-off test targeting one's own, countries would need to develop military infrastructure, organizational capabilities, and dedicated space defense units. Doing so would make destroying satellites during a conflict a real option rather than just a theoretical possibility; however, such a capability would require creating structures, plans, and methodologies that differ from those of traditional missile defense systems. Any such developments could be indicators of a country's intentions. In 2020, then-head of the Russian Air Space Forces General Surovikin stated that the new S-500 mobile missile defense system "can be called a first generation of space defense systems, as in the future it will be able to destroy low-orbiting satellites and space-based strike systems."[55] The first S-500 regiment went on combat duty in October 2021 in Moscow. There have been no notable updates in this area since.

Another factor to consider is national and international discussions and deliberations on the use of force in outer space. Any decision to use such force would break the taboo, making it more likely that satellites of all types and belonging to all countries would become targets. Any physical destruction of a satellite has a high likelihood of creating a debris cloud that is equally dangerous for the satellites of the attacker as well as for the space infrastructure of third-party countries. Internally, agencies and departments (both civilian and military) interested in preserving their ability to use satellites would likely oppose risking a space war. In the international arena, major spacefaring nations such as China and India could also see their infrastructure threatened, which might encourage them to try to prevent such a scenario.

Finally, current trends in satellite use might make the whole concept of destroying an adversary's satellites unrealistic. For example, Starlink currently has more than 4,500 satellites in orbit and has the capacity to build and launch hundreds of new ones in a month. The sheer volume of satellites makes shooting them all down impractical. The world's major militaries do not have such far-reaching plans, but even they started thinking about maintaining constellations consisting of hundreds of satellites, with the capability of launching replacement

[55] Anastasia Sviridova, "To Ensure Air Superiority Remains with Us" ["Чтобы господство в воздухе оставалось за нами"], Krasnaya Zvezda, July 3, 2020, http://redstar.ru/chtoby-gospodstvo-v-vozduhe-ostavalos-za-nami/.

satellites within 24 hours of a launch request.[56] In April 2023, the director of the US Space Development Agency stated that he is not concerned with physical threats partly because "it will cost more to shoot down a single satellite than it will cost to build that single satellite." However, he warned about potential cyber threats that could incapacitate entire constellations of satellites or cause breaches in the supply chain.[57]

[56] Eric Berger, "The US Military Just Proved It Can Get Satellites into Space Super Fast," Ars Technica, Sept. 15, 2023, https://arstechnica.com/space/2023/09/firefly-and-space-force-demonstrate-ability-to-rapidly-launch-a-satellite/.

[57] Greg Hadley, "SDA's Tournear 'Just Not' Afraid of Satellite Shootdowns. Supply Chain Is the Greater Worry," Air and Space Forces, Apr. 5, 2023, https://www.airandspaceforces.com/sda-tournear-kinetic-attacks-satellites/.

Conclusions

Strategic stability is a wide-ranging concept describing the situation of equilibrium between the nuclear forces of the US and Russia. This reality was created through trial and error during the Cold War and has been enshrined in treaties, nuclear force structures and postures, and ways of thinking and doing things in Moscow and Washington. It would be very hard for a single development to undermine such a system in total or even in a certain domain, such as outer space.

At the same time, the Russian invasion of Ukraine and subsequent developments did influence a variety of spheres, including outer space. And the implications for US-Russian strategic stability have been mostly negative, although they are not very pronounced currently.

The taboo against kinetic attacks against satellites has held for the last 20 months, demonstrating that previous cost-benefit analyses are broadly in place: countries are still deterred from attacking each other's NC3 assets and do not want to provoke a full-scale war that could escalate to the nuclear level.

At the same time, Russian legal developments, statements, and actions hint at a new approach to targeting satellites, one with more of a gray area. Instead of a blanket rejection of targeting space objects, a discussion seems to be underway concerning what types of satellites could be targeted, under what conditions, and with what type of weapons. But any use of force against satellites would be a slippery slope that might put NC3 infrastructure in the crossfire, which would have significant escalation potential.

On the flip side, development of large satellite constellations might make attacks against space infrastructure meaningless, moving from deterrence by punishment to deterrence by denial.

Hostilities in Ukraine also highlighted the importance of space infrastructure for success on the conventional battlefield. Countries providing such an infrastructure to the warring sides will be blamed for fueling or even participating in the conflict. The situation becomes even more complicated when nuclear or dual-capable systems are in the mix.

Finally, Western sanctions imposed on Russia might lead to degradation of the satellite component of its early warning system, which would also undermine strategic stability.

In addition, Moscow and Washington do not have any dedicated bilateral channels left through which to discuss issues of strategic stability and space. This lack may aggravate any contradictions that might arise between the states and make crisis prevention much less likely.

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